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(54) Title: HOT-MELT ADHESIVE COMPOSITION

(57) Abstract

The present invention is directed to a hot-melt adhesive containing at least one olefin-based polymer such as a propylene/1-hexene copolymer. The adhesive contains an amount of a low viscosity, substantially crystalline wax sufficient to improve the elastic delamination resistance of the adhesive. The adhesives are particularly useful in disposable diaper construction.

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HOT-MELT ADHESIVE COMPOSITION

Field of Invention

The present invention concerns hot-melt adhesives (HMAs) containing at least one olefin-based polymer useful as disposable diaper adhesives.

Background of the Invention

Recent trends in the design of disposable diapers have necessitated the development of more versatile adhesives for use in the diapers. The trend of the industry toward diapers with elastic bands on either the legs or the waist of the diaper have made it necessary to use a stronger more delamination resistant adhesive to hold the elastic in place. Most diaper manufacturers prefer to use one hot-melt adhesive to both construct the diaper (that is to bind the nonwoven top sheet and filler to the polyethylene back sheet) and to hold the elastic on the leg or waist of the diaper. It is well known that polyolefin based HMAs are suitable for the construction of diapers by construction techniques as currently practiced such as multiple fine line, hot-melt spray, hot-melt foam, slot coating operations, and various screen coating methods. However, polyolefin-based HMAs are traditionally not suitable for the bonding of the elastic to the diapers, that is, the elastic delamination resistance is insufficient for such an application. For this reason, adhesives based on styrene rubbers such as S-I-S block copolymers or S-B-S block copolymers are used (see, for example, U.S. Patent 4,526,577).

The use of two HMAs on the same diaper poses some problems for the diaper manufacturer. They must insure the right adhesive is used in the right melt tank and is applied to the correct place on the

diaper. Therefore, an adhesive that is capable of performing both types of bonding functions is highly desirable.

Wax is traditionally added to hot-melt adhesives with the objective of controlling viscosity of the adhesive. That is, it is a diluent and may in some cases lower the cost of the adhesive. For the most part waxes are not known to add to the strength of HMAs but rather are used to control set time or open time or viscosity.

This invention describes a polyolefin-based HMA suitable for use as both the adhesive of construction of disposable diapers and as the adhesive to hold the elastic onto the leg or waistband. Thus a universal diaper adhesive based on polyolefins has been developed. It has been surprisingly found that the addition of a low viscosity, substantially crystalline wax to a polyolefin-based HMA substantially improves the elastic delamination resistance. The formulation of an HMA containing an olefin-based polymer having sufficient elastic delamination resistance to meet the demands of the universal diaper adhesive is a significant advance in the art.

Summary of the Invention

The present invention is directed to a hot-melt adhesive composition which has a blend of properties that makes it ideally suited for use with disposable diapers.

More specifically, the present invention is directed to a hot-melt adhesive composition having a viscosity of about 3,000 to about 25,000 centipoise at 135°C and a Ring and Ball softening point of about 90°C to about 125°C wherein said adhesive composition contains at least one substantially amorphous

olefin-based polymer with an acid number less than about 0.5, said adhesive composition having blended therein, in an amount sufficient to improve the elastic delamination resistance of the composition, at least one substantially crystalline, low viscosity hydrocarbon wax containing substantially no propylene and having a melt viscosity of from about 3 to about 4,000 centipoise at 150°C and a melting point of from about 90°C to about 125°C.

Preferably, the composition of the present invention is a hot-melt adhesive composition having a viscosity of about 3,000 to about 25,000 centipoise at 135°C and a Ring and Ball softening point of about 90°C to about 125°C, said composition comprising a blend of:

(a) at least one substantially amorphous olefin-based polymer having an acid number of less than about 0.5,

(b) at least one tackifier, and

(c) at least one substantially crystalline, low viscosity hydrocarbon wax containing substantially no propylene and having a melt viscosity of from about 3 to about 4,000 centipoise at 150°C and a melting point of from about 90°C to about 125°C,

the concentration of components (a), (b), and (c) being such that said adhesive composition has an elastic delamination resistance of at least about 4 hours wherein elastic delamination resistance is the length of time a polyethylene to elastic bond can withstand the stress of elastic relaxation at body temperature.

Most preferably, the composition of the present invention is a hot-melt adhesive composition having a viscosity of about 3,000 to about 25,000 centipoise at 135°C and a Ring and Ball softening point of about

90°C to about 125°C, said composition comprising a blend of:

(i) about 30 to about 70 weight percent of at least one substantially amorphous propylene/C_4 to C_{10} higher 1-olefin random copolymer containing from about 20 to about 50 weight percent of higher 1-olefin said polymer having a melt viscosity of from about 2,000 to about 20,000 centipoise at 190°C,

(ii) about 20 to about 50 weight percent of at least one solid tackifier comprising hydrocarbon resins or polyterpene resins, said solid tackifier having a Ring and Ball softening point of from about 70°C to about 145°C,

(iii) 0 to about 30 weight percent of at least one liquid tackifier having a viscosity of from about 5 to about 500 centipoise at 95°C and a Ring and Ball softening point of from about 5°C to about 30°C, and

(iv) from about 1 to about 10 weight percent of at least one substantially crystalline, low viscosity hydrocarbon wax containing substantially no propylene and having a melt viscosity of from about 3 to about 4,000 centipoise at 150°C and a melting point of from about 90°C to about 125°C.

The present invention is also directed to a method for applying the compositions of the invention to a disposable diaper and to articles comprising the composition of the invention in combination with a disposable diaper.

Detailed Description of the Invention

The adhesive compositions of the present invention preferably have a melt viscosity of about 4,000 to about 10,000 centipoise at 135°C. Melt viscosities of the adhesive compositions and the various components thereof can be determined using a Brookfield Model RTV Thermosel viscometer using a Number 27 spindle in accordance with American Society for Testing and Materials (ASTM) Procedure 1824-66.

The adhesive compositions of the present invention preferably have a Ring and Ball softening point (RBSP) of about 100°C to about 120°C. RBSP for the adhesive compositions and various components thereof can be determined by use of ASTM Procedure E-28.

The Gardner color of the adhesive compositions of the present invention preferably is less than about 7, most preferably less than about 3. Gardner color for the adhesive compositions and various components thereof can be determined by use of ASTM Procedure D-1544.

Bond strength of the adhesives of the present invention is at least about 200 grams based on an adhesive coating weight of 2.1 milligrams (mg) per inch (0.83 mg/cm), preferably at least 300 grams. At about 300 grams substrate failure occurs. Bond strength can be measured by the controlled destruction of the bonds by an Instron tensile tester at 10 inches (25.4 cm) per minute (min.). More specifically, nonwoven fabric (e.g., polypropylene or polyester nonwoven fabric commonly used in disposable diaper construction) is bonded by applying a single 2.1 mg per inch (0.83 mg/cm) bead of adhesive on a moving web of polyethylene film at a melt temperature of 140°C, then applying sufficient nip pressure to bring the two substances in contact. The open time

is about 1 second, and the compression time is less than 0.5 seconds. The nonwoven fabric is then pulled from the polyethylene in a T-peel mode and the average amount of force required to pull apart the two substances is the bond strength.

Tensile strength of the adhesive compositions of the present invention is typically greater than about 10 pounds per square inch (psi) (68.95 kilopascal), and preferably about 20 to about 50 psi (about 137.90 to about 344.74 kilopascal). Tensile strength can be determined by use of ASTM Procedure D-638-72.

The Cone penetration value of the adhesive compositions of the present invention is typically greater than about 10 decimillimeters (dmm), and preferably greater than about 20 dmm. Cone penetration can be measured by use of ASTM Procedure D-1403.

The elastic delamination resistance of the compositions of the present invention is greater than about 4 hours, preferably greater than about 8 hours, more preferably greater than about 24 hours, and most preferably greater than about 100 hours. The elastic delamination resistance is determined by the following procedure:

Elastic, 0.25 inches (0.635 cm) wide and 0.007 (0.01778 cm) inches thick, typically used in disposable diaper construction (can be obtained from Fulflex Company) is expanded to 100% elongation. Test adhesive is applied as a bead at 275°F (135°C) to the elongated elastic which is then immediately brought into contact with polyethylene film and passed through a compression roller. The hot-melt adhesive bead weight is controlled at 10 to 15 mg per linear inch of polyethylene film. The polyethylene film is 1-2 mils thick and is a low density polyethylene blended with linear low density

polyethylene or high density polyethylene. The polyethylene film is pigmented with TiO_2 and corona treated and is typical of polyethylene film used in disposable diaper manufacture. The bonded material is allowed to relax and age overnight. After aging, specimens 8-inches long are cut. The center 6 inch (15.25 cm) sections of the specimens are elongated to 12 inches (30.48 cm) (100% elongation) and then the polyethylene is clamped in a metal jig with the elastic surface up. The elastic is not clamped. The specimens are then placed in an oven at 100°F (37.78°C) for various times. The time at which a visible, continuous delamination or end release is observed is the elastic delamination resistance.

The adhesive compositions of the present invention contain at least one substantially amorphous olefin-based polymer with an acid number less than about 0.5. The olefin-based polymer is preferably present as an amount of 30 to about 70 weight percent of the adhesive composition, more preferably about 40 to about 65 weight percent. The olefin-based polymer can be a copolymer or a polymer made from more than two monomers. Such polymers are known to be useful in adhesive formulations and many are commercially available. The olefin-based polymers can be prepared using techniques known in the art, for example, by use of the techniques disclosed in U.S. Patents 3,954,697 and 4,259,470, both of which are incorporated herein by reference.

Preferred olefin-based polymers have a melt viscosity of from about 2,000 to about 20,000 centipoise (cp) at 190°C, preferably about 4,000 to about 20,000 cp. Perferred olefin-based polymers are propylene/C_4 to C_{10} higher 1-olefin random copolymers having a higher 1-olefin content of about 20 to about 50 weight percent, preferably about

30 to about 40 weight percent. The preferred higher 1-olefins in the copolymers are 1-hexene and 1-butene with 1-hexene being most preferred. It is perferred that the RBSP for such copolymers is about 100°C to about 134°C, more preferably about 124°C to about 134°C for a propylene/hexene copolymer and about 100°C to about 120°C for a propylene/butene copolymer.

The low viscosity, substantially crystalline hydrocarbon wax in the adhesive composition of the present invention is present in an amount sufficient to improve the elastic delamination resistance of the composition. Typically this amount is about 1 to about 10 weight percent of the composition, preferably about 3 to about 7 weight percent. The hydrocarbon waxes in the adhesive compositions of the present invention are widely available articles of commerce and can be prepared by known techniques. These waxes are preferably polyethylene waxes. Such polyethylene waxes can be made by direct synthesis or by degrading polyethylene, preferably high density polyethylene (i.e., $\geq$ about 0.94 grams(g)/cubic centimeters (cc)) to the desired viscosity. The waxes have a melt viscosity of from about 3 to about 4,000 centipoise, preferably about 3 to about 1,000 centipoise and a melting point of from about 90°C to about 125°C, preferably about 105°C to about 125°C. The waxes also preferably have a penetration hardness at 23°C of about 0.1 dmm to about 10 dmm. Penetration hardness can be measured by ASTM procedure D-1321-76. Specific waxes useful in the present invention include Epolene C-15 and Epolene N-45, available from Eastman Chemical Products, Inc., Bareco 1000 and Bareco BE^2 195, available from Petrolite Corp., and Paraflint H1, available from Moore and Munger, Inc. Preferred is Bareco 1000 and Epolene N-45.

The adhesive compositions of the present invention typically contain one or more tackifiers in an amount of about 20 to about 60 weight percent of the composition. Solid tackifiers are typically present in an amount of from 20 to 50 weight percent, preferably 25 to 40 weight percent. The solid tackifiers can be hydrocarbon resins such as DAC-B hydrocarbon resin prepared according to the process disclosed in U.S. Patent 3,701,760 as well as other hydrocarbon resins, polyterpenes, and the like. One such hydrocarbon tackifying resin is a hydrocarbon resin having a softening point of about 100°C and available commercially as Eastotac H-100 from Eastman Chemical Products, Inc. Other hydrocarbon tackifying resins can be prepared by the polymerization of monomers consisting primarily of olefins and diolefins and include, for example, the residual by-product monomers resulting from the manufacture of isoprene. These hydrocarbon tackifying resins typically exhibit a RBSP of from about 70°C to about 145°C; an acid number of from about 0-2, a saponification value of less than about 1; and an iodine value of from about 30 to 100. Examples of such commerically available resins based on a C_5-olefin fraction of this type are "Wingtack" 95 and "Wingtack" 115 tackifying resins sold by Goodyear Tire and Rubber Company, the Sta-Tac and Betaprene A or H resins sold by Reichhold Chemical Corporation, and Escorez resins sold by Exxon Chemical Co.

Also, other suitable solid tackifier resins are the terpene polymers such as the polymeric, resinous materials obtained by polymerization and/or copolymerization of terpene hydrocarbons such as the alicyclic, monocyclic, and bicyclic monoterpenes and their mixtures, including alloocimene, carene, isomerized pinene, pinene, dipentene, terpinene,

terpinolene, limonene, terpentine, a terpene cut or fraction, and various other terpenes. Particularly useful starting materials are terpene mixtures containing at least 20 percent beta-pinene and/or limonene or dipentene (racemic limonene), and the "sulfate terpentine" obtained as a by-product in the sulfate pulping process. Commercially available resins of the terpene type include the Zonarez terpene B-Series and 7000 Series resins from Arizona Chemical Corp. and Nirez resins from Reichhold Chemical Corp. The typical properties reported for the Zonarez terpene resins include RBSPs of about 55° to 125°C (ASTM E-28-67), color of 2 to 3 (Gardner 1963, 50% in heptane), acid number of less than 1 (ASTM D465-59), saponification number of less than 1 (ASTM D464-59) and specific gravity at 25°C of 0.96 to 0.99 (ASTM D1963-61).

The liquid tackifiers are typically present in an amount of from 0 to about 30 weight percent of the adhesive composition, preferably 15 to 25 weight percent. The liquid tackifiers are commercial items and/or can be prepared by techniques known in the art, for example, by the techniques described in U.S. Patent 3,872,064, incorporated herein by reference. The liquid tackifiers are preferably liquid hydrocarbon resins such as synthetic polyterpene or other petroleum hydrocarbon resins. Specific examples include "Wingtack" 10 from Goodyear Tire and Rubber Company and "Escorez" 2520 (also known as ECR-140) from Exxon Chemical Co. The liquid tackifiers have a melt viscosity of about 10,000 to about 50,000 cp at 23°C, preferably about 20,000 to about 40,000; a RBSP of about 5 to about 30, preferably about 10 to about 20, and a glass transition temperature (Tg) of about -10°C to about -30°C.

The adhesive compositions of this invention are prepared by blending together the adhesive components in the melt at a temperature of about 160°C to about 200°C until a homogeneous mixture is obtained. Various methods of blending materials of this type are known to the art and any method that produces a homogeneous mixture is satisfactory. These components blend easily in the melt and a heated vessel equipped with a stirrer is all that is required. For example, a Cowles stirrer provides effective mixing for preparing these compositions. Solvents such as hexane, heptane, mineral spirits, xylene, toluene, benzene, chlorinated hydrocarbons, etc., are not needed to prepare the compositions of this invention; however, they can be used if desired.

In addition to the hereinabove described adhesive components, it is desirable for the adhesive compositions to contain about 0.1 percent to about 1.5 percent by weight, preferably about 0.25 percent to 1.0 percent by weight, of one or more antioxidants. Antioxidants that are effective include, for example, tris(di-t-butyl-p-hydroxy-benzyl)-trimethylbenzene (Ionox 330), alkylated bisphenol (Naugawhite), zinc dibutyl dithiocarbamate (Butyl Zimate), and 4,4'-methylene bis(2,6-di-tert-butylphenol)(Ethyl 702), tetrakis[methylene(3,5-di-tert-butyl-4-hydroxyhydrocinnamate(methane] (Irganox 1010), lauryl stearyl thiodipropionate (Cyanox 1212), and dilauryl 3,3'-thiodipropionate (Cyanox LTDP) and 2,6-di-tert-butyl-p-cresol (BHT) and the like.

Additional additives such as nucleating agents, pigments, colorants, fillers, solvents, and the like can also be added to the adhesive compositions of the present invention.

The adhesive compositions of the present invention can be made into any physical form typically used in the art. When formed into slats, the compositions typically are coated with a wax which may or may not be a wax within the scope of the invention.

In the method of the present invention, the adhesive composition is applied to a disposable diaper or portion thereof using techniques known in the art. For example, the adhesive composition can be applied by multiple fine line, hot-melt spray, hot-melt foam, slot coating operations, and various screen coating methods. The amount of adhesive composition applied to a diaper is that amount sufficient to result in bonds that will withstand typical storage and end use conditions. It is contemplated that the adhesive compositions of the present invention are useful in applications other than diapers, for example, in sanitary napkins and bed pad construction.

In the adhesive compositions of the present invention, as appreciated by one skilled in the art, the particular proportions of components necessary to achieve specific desired properties will vary depending on the nature of the particular components.

This invention can be further illustrated by the following examples thereof, although it will be understood that these examples are included merely for purposes of illustration and are not intended to limit the scope of the invention.

Examples 1-2

An adhesive composition was made in accordance with the present invention containing 5 weight % of a hydrocarbon wax as described herein (Example 2). For comparison, an adhesive composition outside the scope of the invention, i.e., not containing a hydrocarbon

wax, was also prepared (Example 1). The two compositions were tested for their respective elastic delamination resistance (EDL). As shown in Table 1, the EDL of Example 1 was only four hours, whereas the EDL of Example 2 was greater than 100 hours.

TABLE 1 - ADHESIVE BLENDS

EXAMPLE NUMBER	1	2
COMPOSITION (Weight %)		
[1]APH 5	26	26
[2]APH 3	17	22
[3]Eastotac H-130W	36.5	26.5
[4]Escorez 2520	20	20
[5]Bareco 1000	-	5.0
[6]Irganox 1010	0.5	0.5
BLEND PROPERTIES		
VISCOSITY @ 135°C, cp	9600	6600
RBSP, °C	113	108
CONE PENETRATION, dmm	18	14
TENSILE STRENGTH, psi (KPa)	15 (103.42)	30 (206.84)
ELASTIC DELAMINATION RESISTANCE		
Time to failure, hrs	4	>100
BOND STRENGTH, grams	200	300 (substrate failed)

[1]APH 5 = amorphous propylene/1-hexene copolymer having a viscosity of 17,000 cp at 190°C, 23 weight % 1-hexene content, and a RBSP of 138°C.

[2]APH 3 = amorphous propylene/1-hexene copolymer having a viscosity of 3,000 cp at 190°C, 55 weight % 1-hexene content, and a RBSP of 114°C.

[3]Eastotac H-130W = solid tackifier, petroleum hydrocarbon resin, RBSP of 130°C melt viscosity at 190°C of 1,000 cp.

[4]Escorez 2520 = liquid tackifier, RBSP of 20°C, Tg of -20°C, melt viscosity of 40,000 cp at 23°C.

[5]Bareco 1000 = high density, low viscosity, crystalline polyethylene wax, melting point of 113°C, penetration hardness of 1 dmm, density of 0.96 g/cc, melt viscosity of 11 cp at 150°C.

[6]Irganox 1010 = antioxidant

Examples 3-8

Adhesive blends having a relatively high proportion of propylene/1-hexene copolymer (i.e. 47%) were prepared in accordance with the present invention. The RBSPs of the blends were varied primarily by adjusting the % hexene content of the copolymer. Variations in the elastic delamination resistance (EDL) were observed, however, in all cases the EDLs were greater than four hours as shown in Table 2.

TABLE 2 - ADHESIVE BLENDS

EXAMPLE NUMBER	3	4	5	6	7	8
BLEND COMPOSITION (Wt %)						
[1]APH	47.0	47.0	47.0	47.0	47.0	47.0
[2]Escorez 2520	19.5	19.5	19.5	19.5	19.5	19.5
[3]Eastotac H-130W	26.0	26.0	26.0	26.0	26.0	26.0
[4]Bareco 1000	3.0	3.0	3.0	3.0	3.0	3.0
[5]Epolene C-15	4.0	4.0	4.0	4.0	4.0	4.0
[6]Irganox 1010	0.5	0.5	0.5	0.5	0.5	0.5
PHYSICAL PROPERTIES OF APH						
Viscosity @ 375°F(190.56°C), cp	5475	8325	7650	9550	7000	5300
RBSP, deg C	132	138	135	132	124	126
% Hexene	36	33	35	36	40	40
PHYSICAL PROPERTIES OF BLEND						
Viscosity @ 135°C, cp	8500	22750	29000	19000	7750	6440
RBSP, °C	111	120.5	116.5	112	107	107
Cone Penetration, dmm	25	23.5	24	22	23	26
ELASTIC DELAMINATION RESISTANCE						
Time to failure, hrs	>47	>47	>4	>4	>4	>8

[1]APH = amorphous propylene/1-hexene copolymer

[2]Escorez 2520 = liquid tackifier, RBSP of 20°C, Tg of -20°C, melt viscosity at 23°C of 40,000 cp.

[3]Eastotac H-130W = solid tackifier, petroleum hydrocarbon resin, RBSP of 130°C, melt viscosity at 190°C of 1,000 cp.

[4]Bareco 1000 = high density, low viscosity, crystalline polyethylene wax, melting point of 113°C, penetration hardness of 1 dmm, density of 0.96 g/cc, melt viscosity of 11 cp at 150°C.

[5]Epolene C-15 = lower density, low viscosity, crystalline polyethylene wax, melting point of 102°C, penetration hardness of 4 dmm, density of 0.91 g/cc, melt viscosity of 3,900 cp at 150°C.

[6]Irganox 1010 = antioxidant

Examples 9-16

Adhesive blends were prepared in accordance with the present invention. The compositions and properties of these blends are shown in Table 3. Example 14 is a comparative example without a wax.

TABLE 3 - ADHESIVE BLENDS

EXAMPLE NUMBER	9	10	11	12	13	14	15	16
COMPOSITION (Wt. %)								
[1]APH	48	-	48	48	48	50.5	50	45.7
[2]APB	-	54.5	-	-	-	-	-	-
[3]Eastotac H-130W	26.5	20	26.5	26.5	26.5	27.9	17.6	25.2
[4]Escorez 2520	20	20	20	20	20	21.1	20.8	19
[5]Bareco 1000	5	-	-	-	-	-	-	-
[6]Epolene N-45	-	5	-	-	-	-	1	10
[7]Epolene C-15	-	-	5	-	-	-	-	-
[8]Bareco Be[2] 195	-	-	-	5	-	-	-	-
[9]Paraflint H-1	-	-	-	-	5	-	-	-
[10]Irganox 1010	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

[1]APH = amorphous propylene/1-hexene copolymer
[2]APB = amorphous propylene/1-butene copolymer
[3]Eastotac H-130W = solid tackifier
[4]Escorez 2520 = liquid tackifier
[5]Bareco 1000 = wax
[6]Epolene N-45 = wax
[7]Epolene C-15 = wax
[8]Bareco Be[2]195 = wax
[9]Paraflint H-1 = wax
[10]Irganox 1010 = antioxidant

TABLE 3- ADHESIVE BLENDS (Continued)

EXAMPLE NUMBER	9	10	11	12	13	14	15	16
PHYSICAL PROPERTIES OF APH AND APB								
Viscosity @ 375°F(190.56°C), cp	5475	10000	5475	5475	5475	5475	5475	5475
RBSP, °C	132	110	132	132	132	132	132	132
% Hexene	36	0	36	36	36	36	36	36
% Butene	0	40	0	0	0	0	0	0
PHYSICAL PROPERTIES OF WAX								
Melting point, °C	113	123	102	91	13	-	123	123
Density, g/cc	0.96	0.95	0.91	0.93	0.94	-	0.95	0.95
Viscosity @ 150°C, cp	11	500	3900	3	3	-	500	500
Wax type	ethylene	ethylene	ethylene	micro-crystalline	Fischer-Tropech	-	ethylene	ethylene
Penetration Hardness, dmm	0.5	0.1	4	7	2	-	0.1	0.1
BLEND PROPERTIES								
VISCOSITY @ 135°C, cp	8000	10500	8000	4880	4880	6880	7100	4200
RBSP, °C	117	117	117	111	103	113	115	117
CONE PENETRATION, dmm	17	18	39	10	18	42	33	14
ELASTIC DELAMINATION RESISTANCE								
Time to failure, hrs	24	24	24	24	24	<1	24	>72

CLAIMS

We claim:

1. A hot-melt adhesive composition having a melt viscosity of 3,000 to 25,000 centipoise at 135°C and a Ring and Ball softening point of 90°C to 125°C wherein said adhesive composition contains at least one substantially amorphous olefin-based polymer with an acid number less than 0.5, said adhesive composition having blended therein, in an amount sufficient to improve the elastic delamination resistance of the composition, at least one substantially crystalline, low viscosity hydrocarbon wax containing substantially no propylene and having a melt viscosity of from 3 to 4,000 centipoise at 150°C and a melting point of from 90°C to 125°C.

2. The composition of Claim 1 wherein said elastic delamination resistance is at least 4 hours.

3. The composition of Claim 1 wherein said elastic delamination resistance is at least 8 hours.

4. The composition of Claim 1 wherein said elastic delamination resistance is at least 24 hours.

5. The composition of Claim 1 which has a cone penetration value as measured by ASTM Procedure D-1403 of at least 10 dmm, a molten Gardner color as measured by ASTM Procedure D-1544 of less than 7, a tensile strength as measured by ASTM Procedure D-638-72 of at least (68.95 KPa), and a bond strength of at least

200 grams per 2.1 mg per inch (0.83 mg/cm) coating weight.

6. The composition of Claim 5 wherein said elastic delamination resistance is at least 8 hours, said cone penetration value is at least 20 dmm, said molten Gardner color is less than 4, said tensile strength is 20 to 50 psi (137.90 to 344.74 KPa), and said bond strength is at least 300 grams per 2.1 mg per inch (0.83 mg/cm) coating weight.

7. The composition of Claim 1 additionally containing at least one tackifier, at least one antioxidant, at least one additional additive or a mixture thereof.

8. The composition of Claim 1 wherein said adhesive composition has a viscosity of 4,000 to 8,000 centipoise at 135°C and a Ring and Ball softening point of 100°C to 120°C.

9. The composition of Claim 1 wherein said hydrocarbon wax is a polyethylene wax having a melt viscosity of from 3 to 4,000 centipoise at 150°C and a penetration hardness at 23°C of 0.1 to 10, and a melting point of 105°C to 125°C.

10. Hot-melt adhesive composition having a melt viscosity of 3,000 to 25,000 centipoise at 135°C and a Ring and Ball softening point of 90°C to 125°C, said composition comprising a blend of:

(a) at least one substantially amorphous olefin-based polymer having an acid number of less than 0.5,

(b) at least one tackifier, and

(c) at least one substantially crystalline, low viscosity hydrocarbon wax containing substantially no propylene and having a melt viscosity of from 3 to 4,000 centipoise at 150°C and a melting point of from 90°C to 125°C,

the concentrations of components (a), (b), and (c) being such that said adhesive composition has an elastic delamination resistance of at least 4 hours wherein elastic delamination resistance is the length of time a polyehtylene to elastic bond can withstand the stress of elastic relaxation at body temperature.

11. The adhesive composition of Claim 10 wherein said adhesive composition has a viscosity of 4,000 to 10,000 centipoise at 135°C and a Ring and Ball softening point of 100°C to 120°C.

12. The composition of Claim 10 wherein said hydrocarbon wax is a polyethylene wax having a melt viscosity of from 3 to 1,000 centipoise at 150°C, a melting point of from 105°C to 125°C, and a penetration hardness of 0.1 to 10.

13. The adhesive composition of Claim 10 wherein component (a) is present in an amount of 30 to 70 weight percent, component (b) is present in an amount of 20 to 60 weight percent, and component (c) is present in an amount of from 1 to 10 weight percent.

14. The adhesive composition of Claim 10 wherein said elastic delamination resistance is at least eight hours.

15. The adhesive compositions of Claim 10 which has a cone penetration as measured by ASTM Procedure D-1403 of at least 10 dmm, a molten Gardner color as measured by ASTM Procedure D-1544 of less than 7, a tensile strength as measured by ASTM Procedure D-638-72 of at least 10 psi (68.95 KPa), a bond strength of at least 200 grams per 2.1 mg per inch (0.83 mg/cm) coating weight, and wherein said elastic delamination resistance is at least 24 hours.

16. The adhesive composition of Claim 15 wherein said cone penetration value is at least 20 dmm, said molten Gardner color is less than 4, said tensile strength is 20 to 50 psi (137.90 to 344.74 KPa), said bond strength is at least 300 grams per 2.1 mg per inch (0.83 mg/cm) coating weight, and said elastic delamination resistance is at least about 100 hours.

17. The composition of Claim 10 additionally containing at least one antioxidant, at least one additional additive or a mixture thereof.

18. A hot-melt adhesive composition having a melt viscosity of 3,000 to 25,000 centipoise at 135°C and a Ring and Ball softening point of 90°C to 125°C, said composition comprising a blend of:

(i) 30 to 70 weight percent of at least one substantially amorphous propylene/C_4 to

C_{10} higher 1-olefin random copolymer containing from 20 to 50 weight percent of higher 1-olefin said copolymer having a melt viscosity of from 2,000 to 20,000 centipoise at 190°C,

(ii) 20 to 50 weight percent of at least one solid tackifier comprising hydrocarbon resins or polyterpene resins said tackifier having a softening point of from 70°C to 145°C.

(iii) 0 to 30 weight percent of at least one liquid tackifier having a viscosity of from 10,000 to 50,000 centipoise at 23°C and a Ring and Ball softening point of from 5°C to 30°C, and

(iv) from 1 to 10 weight percent of at least one high density, substantially crystalline, low viscosity hydrocarbon wax containing substantially no propylene and having a melt viscosity of from 3 to 4,000 centipoise at 150°C and a melting point of from 90°C to 125°C.

19. The adhesive composition of Claim 18 which has a cone penetration value as measured by ASTM Procedure D-1403 of at least 10 dmm, a molten Gardner color as measured by ASTM Procedure D-1544 of less than 7, a tensile strength as measured by ASTM Procedure D-638-72 of at least 10 psi (68.95 KPa), a bond strength of at least 200 grams per 2.1 mg per inch (0.83 mg/cm) coating weight, and wherein said elastic

delamination resistance is at least 4 hours.

20. The adhesive composition of Claim 18 wherein said cone penetration value is at least 20 dmm, said molten Gardner color is less than four, said tensile strength is 20 to 50 psi (137.90 to 344.74 KPa), said bond strength is at least 300 grams per 2.1/mg per inch (0.83 mg/cm) coating weight, and said elastic delamination resistance is at least 8 hours.

21. The composition of Claim 20 wherein said delamination resistance is at least 24 hours.

22. The composition of Claim 18 wherein component (i) comprises: 40 to 65 weight percent of at least one substantially amorphous propylene/C_4 to C_{10} higher 1-olefin random copolymer containing from 30 to 40 weight percent at higher 1-olefin said copolymer having a melt viscosity of from 4,000 to 20,000 centipoise at 190°C and having a Ring and Ball softening point of 100°C to 134°C.

Component (ii) comprises: 25 to 40 weight percent of at least one solid tackifier, comprising hydrocarbon resins or polyterpene resins said solid tackifier having a softening point of from 120°C to 145°C,

Component (iii) comprises: from 15 to 25 weight percent of at least one liquid tackifier having a viscosity of from 20,000 to 40,000 centipoise at 23°C, a Ring and Ball softening point of from about 10°C to about 20°C, and a Tg of about -10°C to about -30°C, and

Component (iv) comprises: from about 3 to about 7 weight percent of at least one substantially crystalline, low viscosity polyethylene wax having a melt viscosity of from about 3 to about 1,000 centipoise at 150°C and a melting point of from about 105°C to about 125°C

23. The adhesive composition of Claim 18 wherein said higher 1-olefin is 1-hexene or 1-butene.

24. The adhesive composition of Claim 22 wherein said higher 1-olefin is 1-hexene or 1-butene.

25. The adhesive composition of Claim 18 wherein said solid tackifier is a C_5 hydrocarbon resin or polyterpene resin.

26. The adhesive composition of Claim 24 wherein said solid tackifier is a C_5 hydrocarbon resin or polyterpene resin.

27. The adhesive composition of Claim 18 wherein said liquid tackifier is a synthetic polyterpene.

28. The adhesive composition of Claim 26 wherein said liquid tackifier is a syntehtic polyterpene.

29. The adhesive composition of Claim 18 additionally comprising an antioxidant, an additional additive or a mixture thereof.

30. The adhesive composition of Claim 28 additionally comprising an antioxidant, an additional additive or a mixture thereof.

31. A method comprising applying the adhesive composition of Claim 1 to a disposable diaper or portion thereof.

32. A method comprising applying the adhesive composition of Claim 10 to a disposable diaper or portion thereof.

33. A method comprising applying the adhesive composition of Claim 18 to a disposable diaper or portion thereof.

34. An article comprising the adhesive composition of Claim 1 in combination with a disposable diaper.

35. An article comprising the adhesive composition of Claim 10 in combination with a disposable diaper.

36. An article comprising the adhesive composition of Claim 18 in combination with a disposable diaper.

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 88/04133

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC4: C 09 J 3/14, A 61 L 15/06

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC4	C 08 L, C 09 J

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	GB, A, 1302283 (BRUNO ROMANIN) 4 January 1973, see page 4, lines 31-37, 64-75,89,92-93 and example 1 --	1-17,31-36
X	US, A, 4471086 (BRUCE W. FOSTER) 11 September 1984, see column 2, line 8 - line 11; column 2, line 52 - line 57; column 3, line 29 - line 40; column 4, line 18 - line 22; claim 1 --	1-17
X	Derwent's abstract No. 31 693 K/13, SU 929 677, publ. week 8313 --	1,7,9-10,12-
A	DE, A, 1960467 (CONTINENTAL CAN COMPANY, INC) 10 September 1970, see claim 1 --	1-8,10, 11,13-17

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
13th March 1989	23 MAR 1989
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	P.C.G. VAN DER PUTTEN

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
X	DE, A1, 2613587 (EASTMAN KODAK CO) 14 October 1976, see page 4, line 29 - page 5, line 9; page 11, line 19 - line 27 --	18-30
A	US, A, 4299745 (DARRYL A. GODFREY) 10 November 1981, see column 1, line 35; claim 1 --	31-36
X	Dialog Information Services, File 351, World Patent Index 81-89, Dialog accession no. 3780842, Mitsui Dupont Polyc: "Hot-melt adhesive compsn. esp. for smooth materials comprises ethylene-alpha olefin copolymer, ethylene-vinyl ester copolymer, tackifier resin and wax" JP 60051768, A, 850323, 8518 (Basic) --	18-30

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/US 88/04133

SA 25735

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 12/01/89
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
GB-A- 1302283	04/01/73	NONE		
US-A- 4471086	11/09/84	NONE		
DE-A- 1960467	10/09/70	NL-A-	7001612	18/08/70
		FR-A-	2030440	13/11/70
		GB-A-	1245187	08/09/71
		CH-A-	506606	30/04/71
		SE-A-C-	377133	23/06/75
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		US-A-	4072812	07/02/78
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US-A- 4299745	10/11/81	NONE		

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